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Three Forks Formation Log to Core Correlation

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The correlations presented in this poster are the working set of tops used by the North Dakota Geological Survey to subdivide the Devonian Three Forks Formation. The subdivisions are based on Christopher's (1961) cross section of core- and log-based tops that extend from southeastern Saskatchewan to the Solomon Bird Bear F 22-22-1 well in Dunn County, North Dakota. Representative core photographs from the Solomon Bird Bear well provide coverage of more-or-less the entire Three Forks section. This core and logs are compared to those from the recently drilled Deadwood Canyon Ranch well in which only the upper portion of the Three Forks was cored. However, the core is one of the more extensive ones taken from the Three Forks in North Dakota since the introduction of modern neutron, density and photoelectric logs.

The lower portion of the Three Forks Formation in the Solomon Bird Bear well consists of massive, faintly bedded to brecciated rocks containing locally abundant anhydrite in the form of nodules and vug-filling cement. These features suggest deposition and/or early diagenesis in an arid, restricted marine or sabkha environment suitable for evapoconcentrated seawater to precipitate anhydrite and possibly induce dolomitization of pre-existing limestone.

The upper portion of the Three Forks differs in the frequency and detail of primary sedimentary structures. In general, the Three Forks above Unit 3 contains centimetre-scale couplets consisting of reddish or greenish clay-sized material alternating with thin layers of light tan silt to very fine sand-sized material that sometimes contains ripple cross-laminations. However, intraformational breccias are common and suggest that several episodes of subaerial exposure occurred locally during Three Forks time.

It might be of interest to note that the top of Unit 3 corresponds to a significant drop in PE. This may reflect a change in lithology that is consistent with a decline in the amount of anhydrite in the portion of the Three Forks that overlies Unit 3. The unconformity at the top of Unit 3, evident in the core photographs presented, is recognized in Saskatchewan (Christopher, 1961), Manitoba (Nicholas, 2006) and North Dakota (Christopher, 1961). The top of Unit 3 therefore appears to be a regional surface that, at least in North Dakota, separates earlier restricted marine sediments containing anhydrite from those deposited under more open, humid, shallow-marine conditions.

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